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Indium tin oxide film by laser sintering based on the nanoparticle

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Indium-Tin Oxide (ITO) thin film was a wide band gap semiconductor and many techniques had been developed to prepare it, among which the vacuum-assisted process such as DC and RF sputtering methods had been the main method. To simplify the process and reduce the cost, the research and use of wet process with ITO nanoparticles as starting material has steadily increased over the last few years. In this paper, we have studied the formation of conductive and transparent ITO film with indium-tin (In-Sn) alloy nanoparticle ink (ITO1Cden, ULVAC) as starting material by laser sintering method using CW laser of 1064 nm wavelength as laser source following a spin-coating process.

As presented in Table 1 and Fig. 1, the ITO films were obtained whose conductivities and transmittances were higher than the ITO film prepared through conventional heat treatment method. The surface resistivity was 272 Ω/sq when the line spacing, scan speed, and laser power were 200 μm, 2000 μm/s and 2.23 W, respectively. The Table 1 indicates that the conditions of laser sintering process, which could influence the resistivity of the film remarkably. The surface resistivity increased with increasing the scan speed because the fusion of the nanoparticles was insufficient if the scan speed is too high. Another remarkable feature in Table 1 is the increase of the surface resistivity with increasing the laser power because the microstructure would be destroyed under the excess irradiation condition. The Fig. 1 exhibits that the film showed excellent transparency in the visible and near-IR region, and the transmittance was 88.5% at 600 nm.

Table 1 Influences of the voltage and scan speed on the resistivity of the ITO film

	Laser power (W)	Line spacing (μm)	Scan speed(μm/s)	Surface resistivity(Ω/sq)
a	2.23	200	1000	Insulated
b	2.23	200	2000	272
c	2.23	200	4000	471
d	2.81	200	2000	1654

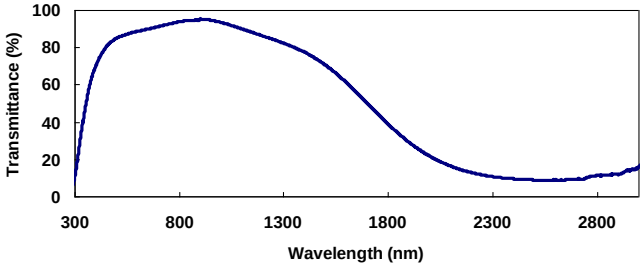

Fig. 1 Transmittance of ITO film prepared by laser sintering method.

Laser power: 2.23 W line spacing: 200 μm, scan speed: 2000 μm/s.